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A time series analysis of U.S. metropolitan and non-metropolitan income divergence

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Abstract This paper employs time series methods to analyze convergence across metropolitan and non-metropolitan regions during the 1969–2001 period. The results suggest that non-metropolitan regions are diverging from below the U.S. average income level, while metropolitan regions show mixed evidence of convergence. These summary results vary by geographic location and the size of the region, with medium-sized metropolitan regions showing the strongest tendencies to converge, while non-metropolitan areas with larger urban centers and small towns showed the strongest tendencies to diverge. Differences in human capital (as well as employment concentrations in farming and mining) appear to have influenced the relative performance of metropolitan and non-metropolitan regions during the last 30 years, suggesting a role for agglomeration economies in the observed trend toward divergence.

JEL Classification C22 · R11 · O18

1 Introduction

Policymakers and researchers have noted long-standing and large income differences between metropolitan and non-metropolitan regions. Indeed, in 2001, per capital personal income for the non-metropolitan U.S. was 69.5% of the metropolitan level, which translates into a per capita income difference of $9,900. In addition, non-metropolitan income is now further below the metropolitan average than it was in 1969, when it was 71.5% of metropolitan income. In other words, non-metropolitan incomes have lagged far below their metropolitan counterparts during the last 30 years and have fallen even further behind. This is important because in 2001 55.6 million (19.5% of U.S. population) people lived in non-metropolitan counties and because these income differences are a crucial input into

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the policymaking process for the national and regional economic development communities.

Theoretical efforts to explain regional income differences and convergence trends often begin with a neoclassical growth model, which assumes that regions share many characteristics in common, especially production technologies (assumed to be subject to constant returns to scale), saving rates, and population growth rates. This economy will exhibit absolute β-convergence, which means that regions will tend to converge to their shared steady state due to diminishing returns to capital.

The theoretical literature also allows for a number of different convergence trends to emerge across metropolitan and non-metropolitan economies, depending on differences in steady state determinants, types of production technologies, and the importance of agglomeration economies. For instance, if regions differ in saving/investment rates, population growth rates or other steady-state determinants, then they need not exhibit absolute β-convergence. Instead, diminishing returns to capital may drive regions to their own unique steady state (for more on conditional β-convergence, see Barro (1991), Mankiw et al. (1992)).

Even after accounting for differences in steady state determinants, we may not find evidence in support of conditional β-convergence if the production function does not exhibit constant returns to scale. This, in turn, might arise from the importance of human capital accumulation. If human capital is less likely to exhibit diminishing returns, then even regions that share identical steady state determinants, and differ only in terms of initial income levels, may fail to converge.

Further, agglomeration economies created by knowledge spillovers may offer another route to income divergence, particularly for cities. In this case, the degree of geographic concentration of an industry or the size of the city in general may generate increasing returns to scale. For instance, a large city may offer its firms and workers an environment that facilitates large knowledge spillovers which make the region more competitive as its size increases (Glaeser et al. (1992)). This has the potential to generate regional income divergence, particularly when the overall economy includes both metropolitan and non-metropolitan regions.

The empirical literature on metropolitan/non-metropolitan convergence trends has noted the fact that, on average, the metropolitan/non-metropolitan per capita income gap has remained wide during the last 30 years and that where convergence has been observed, it has been within groups of metropolitan or non-metropolitan regions, rather than between them (Henry (1993), Nissan and Carter (1999), Hammond and Thompson (2006), and Hammond (2003)). However, the literature has focused on the evolution of the overall income distribution, without analyzing in detail the convergence characteristics of particular regions.

The contribution of this paper is to apply time series methods developed by Carlino and Mills (1993, 1996) to study the aggregate, sub-group, and regional convergence trends exhibited by metropolitan and non-metropolitan regions within the lower 48 U.S. states during the 1969–2001 period. The empirical analysis tests metropolitan and non-metropolitan aggregates for two forms of convergence (stochastic and conditional β-convergence). The results for per capita income suggest that non-metropolitan income has been diverging from below the national average, while metropolitan income has shown little significant evidence of either convergence to the national income level or divergence from it.

I also find a strong association for metropolitan zones between high initial levels of educational attainment (measured as the share of residents with four or more years of college) and high starting income levels and strong subsequent income growth. This suggests that agglomeration economies may have played a role in the observed non-convergence of metropolitan zones during the last 30 years. For non-metropolitan regions, those with initial concentrations in farming and mining exhibited the strongest tendencies to diverge from below the U.S. average income level. Non-metropolitan zones with higher initial manufacturing employment shares showed more mixed results.

The remainder of this paper proceeds as follows. Section 2 develops the time series methodology and provides a discussion of the data and regional aggregation. Section 3 examines the empirical results by region type and by Census region. Section 4 concludes the paper.

2 Methodology, data, and regional aggregation

The majority of the empirical research directed toward U.S. regional convergence has focused on states or multi-state aggregates, with a few examinations for metropolitan areas and counties. With respect to convergence across metropolitan and non-metropolitan regions, the literature to date has found little evidence of income convergence during the last 30 years. This includes investigations utilizing a wide variety of empirical approaches, including the σ-convergence approach of Nissan and Carter (1999), the absolute and conditional β-convergence approach of Henry (1993), the distributional dynamics approach of Hammond and Thompson (2006), and the spatial Markov approach of Hammond (2003).

Even within countries there are good reasons to expect steady state differences across regions, due to differences in educational attainment, industrial mix, and other structural factors that differ across states and sub-state regions. Carlino and Mills (1993, 1996), CM henceforth, employ a time series approach to convergence that allows for persistent long-run income differentials across regions.[1] Their approach differs from the cross-section (absolute and conditional β-convergence) and distribution dynamics approaches, in that it allows the researcher to determine convergence or divergence for each region individually, while allowing for long-run income differentials and differences in rates of convergence across regions.

CM specify a time invariant equilibrium income differential (RPCPI^e) for each region (I suppress region subscripts), where RPCPI is log of region income relative to the national average. They allow deviations from this equilibrium income differential, μ_t, which evolves over time according to,

$$\mu_t = \upsilon_0 + \beta\mathrm{TREND} + \upsilon_t,$$

where υ_0 is the initial deviation from equilibrium, TREND is a time trend, and β is the deterministic rate of convergence. This setup allows the empirical analysis to

[1] Kane (2001) extends the time series approach using recursive parameter estimation techniques. The results suggest stronger trends toward convergence for BEA multi-state regions than those found by Carlino and Mills (1993).

test a form of conditional β-convergence. If υ_0>0 (<0) then we expect β to be negative (positive). Gathering together the setup so far we have,

$$\mathrm{RPCPI_t} = \alpha + \beta\mathrm{TREND} + \upsilon_t, \quad (1)$$

where α=(RPCPI^e+ υ_0) and υ_t is modeled as an AR(2) process:

$$(1-\rho L)(1-\phi L)\upsilon_t = \varepsilon_t, \quad (2)$$

where L is the lag operator and ε_t is the serially uncorrelated shock to υ_t. Thus, regional relative income is characterized by a (possibly) non-zero initial and equilibrium income differential and a dynamic process of convergence to that equilibrium.

The CM approach focuses on two aspects of convergence. First, a regional relative income series that exhibits a unit root is inconsistent with any version of the convergence hypothesis. In other words, a series which contains a stochastic trend cannot be said to converge in any sense. With a little re-writing (by substituting Eq. 2 into 1) it is possible to perform a unit-root test on relative regional income using the Augmented Dickey–Fuller (ADF) form:

$$\Delta\,\mathrm{RPCPI_t} = \mathrm{DRIFT} + b\mathrm{TREND} + c\mathrm{RPCPI}_{t-1} + d\Delta\mathrm{RPCPI}_{t-1.}$$

From this estimation, α, β, ρ, and ϕ can be recovered, as CM show. In addition, the statistical significance of the estimate of (c) provides the basis for the unit root test. In addition, CM use alternative measures of persistence, including impulse response functions and a non-parametric measure based on a ratio of variances.

Second, the relationship between α and the convergence parameter (β) should be negative, so that a region which is above (below) its initial and equilibrium income differential descends (ascends) toward its equilibrium value.[2] It is possible to use the recovered estimates of α and β from the model estimation to test hypotheses regarding the sign and significance of the deterministic regressors.

In order to examine the time series properties of metropolitan and non-metropolitan per capita personal income, I aggregate counties for each region type into a single weighted average for each year, using,

$$\mathrm{PCPI}_{R,t} = \frac{\sum_{i=1}^{R} \mathrm{Personal\ Income}_{\mathrm{i},t}}{\sum_{i=1}^{R} \mathrm{Population}_{i,t}},$$

where t indexes time, i indexes counties of a particular region type (either metropolitan or non-metropolitan), and R is the total number of counties in each region type. Finally, I express each aggregate relative to U.S. per capita personal income (and take the natural logarithm) to form $\mathrm{RPCPI}_{R,t}$.

The measure of income employed is per capita personal income, which is available for all U.S. counties from 1969–2001 on the Regional Economic

[2] The estimation does not separately identify RPCPI^e and υ_0 Thus, it is possible for υ_0 to be large and opposite in sign from RPCPI^e, as CM note, and thus for estimates of α and β to be of the same sign even though the series exhibits conditional β-convergence.

Information System CD-ROM issued in May 2003. Personal income is a broad-based measure, which includes income from work, asset income, and transfer income.[3]

One advantage of the time series approach is that it allows us to consider the convergence properties of each region relative to the national average. In order to focus the analysis on coherent economic regions, I will aggregate county-level personal income and population data to reflect local labor market regions using ERS commuting zones. These zones are defined using commuting flow data from the 1990 Census (Tolbert and Sizer (1996)). Commuting zones are (usually, but not necessarily, multi-county) mutually exclusive and exhaustive regions designed to encompass a local labor market. They allow us to characterize sub-state economic trends without resorting to county-level data, which will tend to be strongly influenced by spatial spillovers.

This research utilizes the 722 ERS zones in the lower 48 United States, which includes 256 metropolitan zones and 466 non-metropolitan zones. Metropolitan zones include at least one Metropolitan Statistical Area (MSA). Note that metropolitan statistical areas may include counties or parts of counties that are primarily rural. Non-metropolitan zones are those that did not include an MSA in 1990.[4] In a small number of cases (17), fringe metropolitan counties also appeared to serve as employment centers for non-metropolitan counties. Tolbert and Sizer (1996) classify these as non-metropolitan. Finally, ERS commuting zones are further classified by the population size of the largest place within the commuting zone, with three sub-classes for metropolitan and non-metropolitan regions.

3 Empirical results

3.1 Metropolitan/non-metropolitan aggregates

As the first panel of Table 1 shows, the ADF tests fail to reject the null of a unit root for either the metropolitan or non-metropolitan aggregates at conventional significance levels. Since these tests tend to have low power, I follow CM by also computing five-year impulse response functions. The results give the share of a unit-shock that remains after 5 years, with the associated standard error. A series which exhibits high levels of persistence, such as series with a unit root, will retain a large share of the effect of a unit shock over time. The results from the impulse response functions are similar for both metropolitan and non-metropolitan aggregates, with roughly 10–11% of a unit shock remaining after 5 years.

[3] This research abstracts from the issue of the relative contribution of each income source to convergence. Hammond and Thompson (2002) show that these contributions may differ. Further, the BEA income data abstracts from considerations of cost of living. It is common in the literature for the U.S. to use data unadjusted for regional costs of living, because these costs are notoriously difficult to measure. However, as Deller et al. (1996), among others, argue, cost-of-living differences may influence the results.

[4] There are 52 commuting zones that are defined as metropolitan in 1990 but were not so defined in 1969. Classifying these new metropolitan zones as non-metropolitan does not alter the qualitative results or their interpretation. Details are available from the author.

Table 1 Estimates of persistence and deterministic components (Standard errors in parentheses)

No break

Region aggregate	Unit root test coefficient: *c* *t*-Statistics	Impulse response 5 years	Variance ratio VR(5) 5 years	Drift	Trend	R^2	LM(2)
Metropolitan	−0.361	0.100	0.977	0.051**	3.37E-04*	0.70	1.08
	−2.787	(0.1240)		(0.0029)	(1.35E-04)		
Non-metropolitan	−0.348	0.111	1.173	−0.195**	−3.30E-03**	0.88	1.46
	−3.028	(0.1336)		(0.0162)	(7.39E-04)		

With break at 1973

Region aggregate	Unit root test coefficient: *e* *t*-Statistics	Impulse response 5 years	Variance ratio VR(5) 5 years	$DRIFT_1$	$DTREND_1$	$DRIFT_2$	$DTREND_2$	R^2	LM(2)
Metropolitan	−0.438	0.037	0.982	0.084**	−5.60E-03	0.056**	1.50E-04	0.86	0.15
	−2.697	(0.1071)		(0.0102)	(0.0028)	(0.0043)	(0.0002)		
Non-metropolitan	−0.490	0.012	1.193	−0.344**	2.40E-02	−0.209**	−2.77E-03**	0.93	0.33
	−3.168	(0.0780)		(0.0616)	(0.0162)	(0.0183)	(0.0008)		

Critical Value at 5% (10%) for Unit Root Test, 25 observations, regression includes drift and trend, −3.60 (−3.24). Critical values from Fuller (1976)
Critical Value at 5% (10%) for Drift=0 in the presence of Unit Root, 25 observations, 2.61 (2.20). Critical value at 5% (10%) for Trend=0 in the presence of Unit Root, 25 observations, 2.85 (2.39). Critical values from Dickey and Fuller (1981). LM(2) is the *F*-statistic from an LM test for serial correlation with two lags. The null hypothesis of this test is no serial correlation
*indicates significance at 10%
**indicates significance at 5%

Finally, since the impulse response functions depend on the estimated parameters I compute variance ratios of the type implemented by CM. The variance ratio at 5 years is computed as,

$$V(5) = \frac{1}{5}\frac{\mathrm{var}(\mathrm{RPCPI}_{t+5} - \mathrm{RPCPI}_t)}{\mathrm{var}(\mathrm{RPCPI}_{t+1} - \mathrm{RPCPI}_t)},$$

The variance ratios (VR(5)) reported in the tables are corrected for drift using: [T/T−5)]V(5). The intuition of the ratio is that if RPCPI contains a unit root, then ΔRPCPI is serially uncorrelated and the ratio of variances over any span equals one. Thus, the closer VR(5) is to one the more persistence the series exhibits.[5] The variance ratio computations are 0.977 for the metropolitan aggregate and 1.173 for the non-metropolitan aggregate.[6] Overall, our parametric and non-parametric results suggest that both the metropolitan and non-metropolitan aggregates exhibit persistence, although there appears to be a bit less persistence in the non-metropolitan aggregate than in the metropolitan aggregate.

Table 1 also contains the estimates of the drift and trend terms for each region aggregate. As expected, the drift term is significantly positive for metropolitan regions and significantly negative for non-metropolitan regions, reflecting the per capita income differences across these region types. Further, the estimated trend terms are significant for each region type, with a positive coefficient on the metropolitan trend and a negative coefficient on the non-metropolitan trend. These results reject the conditional β-convergence hypothesis, since, for each aggregate, the drift and trend terms have the same sign. This further suggests that the metropolitan aggregate is diverging from above, while the non-metropolitan aggregate is diverging from below.

As is well known, the results of unit root tests are sensitive to the presence of structural breaks, tending to fail to reject the null of a unit root when unaccounted for structural breaks are present. While it can be difficult to identify structural breaks in a time series, a graphical analysis of metropolitan and non-metropolitan per capita personal income trends suggests that 1973 might be a good candidate for further analysis. This also coincides with the timing of agricultural and energy price shocks which may have influenced the evolution of metropolitan and non-metropolitan performance.[7] In order to allow for a shift in the equilibrium income differential and in the rate of convergence, I include binary variables for both the

[5] The asymptotic standard error, from Campbell and Mankiw (1989), is computed as $\frac{\mathrm{VR}(5)=1}{\sqrt{\frac{3}{4}\left[\frac{T}{N+1}\right]}}$, with 33 observations available, the standard error is 0.49.

[6] Results from Carlino and Mills (1993) for the 1929–1990 period using BEA state regions, and after accounting for a break in 1946, range from 0.22–0.00 for the 5-year impulse response and from 1.09–0.31 for the variance ratio. Results from Carlino and Mills (1996) using U.S. states, and after accounting for a break in 1946, range from 0.7–0.0 for the 5-year impulse response and from 1.72–0.29 for the variance ratio.

[7] I also follow Perron (1989) in this choice of an exogenously determined break point. Perron (1997), Ben-David et al. (2003) point out that allowing for endogenously determined break points (or for multiple break points) may increase the number of rejections of the null of a unit root.

drift and trend term in our measures of persistence. The estimated regression for each aggregate region type then becomes,

$$\Delta \mathrm{RPCPI}_t = \mathrm{DRIFT}_1 + \mathrm{DRIFT}_2 + c\mathrm{DTREND}_1 + d\mathrm{DTREND}_2 + e\mathrm{RPCPI}_{t-1} + f\Delta RPCPI_{t-1},$$

where DRIFT_1=1 until 1972 and zero after, DRIFT_2=0 until 1972 and one after, DTREND_1=t until 1972 and zero after, and DTREND_2=0 until 1972 and t after.

The persistence results allowing for a structural break in 1973 are summarized in the bottom panel of Table 1. The results suggest the presence of a structural break in each aggregate in 1973. However, allowing for this break does little to change the overall persistence results. The ADF unit root tests still fail to reject the null of a unit root, the impulse responses, evaluated at 5 years, show little remaining impact of a unit shock, and the variance ratio tests suggest a bit more persistence in the metropolitan aggregate than in the non-metropolitan aggregate.

The tests for conditional β-convergence also continue to show evidence of divergence. For the DRIFT_2 and DTREND_2 terms for the metropolitan aggregate we find less evidence in favor of divergence. The drift and trend terms still have the same sign, but the DTREND_2 term is no longer statistically significant at the 10% level. For the non-metropolitan aggregate, the results again suggest divergence from the U.S., with the DRIFT_2 and DTREND_2 terms having the same sign and the DTREND_2 term significant at the 5% level.

Overall, the results suggest that metropolitan and non-metropolitan aggregates are not converging to the U.S. average and thus not to each other. Further, these results suggest not only the lack of convergence, but the outright divergence of non-metropolitan income from the metropolitan aggregate.

3.2 Metropolitan/non-metropolitan commuting zones

One of the strengths of the time series methodology employed here is that it allows equilibrium income differentials and speeds of convergence or divergence to vary across the regions under study. I now exploit this strength by applying it to all ERS commuting zone regions.[8]

Of the 722 ERS zones, 17.5% of reject the null of a unit root at the 10% significance level. In contrast, 8.6% of metropolitan zones reject the null of a unit root, compared to 22.3% of non-metropolitan regions. The impulse response results show that 75.3% of ERS zones retained less than 25% of a unit shock after 5 years, compared to 59.4 and 84.1% for metropolitan and non-metropolitan zones, respectively. Finally, 54.6% of ERS zones report variance ratio statistics at 5 years that are either below 0.51 or above 1.49 (above or below one standard deviation), compared to 57.0% of metropolitan zones and 53.2% of non-metropolitan zones. Overall, the persistence results at the commuting-zone level echo the aggregate results: the zones exhibit persistence and there appears to be more persistence in metropolitan zones than in non-metropolitan zones. This suggests that stochastic convergence is more prevalent across non-metropolitan than metropolitan regions.

[8] I summarize the results here. Full details are available from the author.

Commuting zone regions are defined as conditionally β-converging if the sign of $DRIFT_2$ and $DTREND_2$ are different, so that a positive (negative) initial and equilibrium income differential should be associated with a negative (positive) coefficient on the convergence parameter. For those zones with $DRIFT_2$ and $DTREND_2$ significant at 10%, 12.9% are conditionally β-converging. The results suggest stronger evidence of convergence for metropolitan zones (18.8% converging) than for non-metropolitan zones (9.7% converging). These results are maintained if we leave aside the issue of significance, with 55.1% of metropolitan zones converging, compared to 42.5% of non-metropolitan zones.

Table 2 breaks these results out by region type and geographic region, using the four Census regions, and expands the conditional β-convergence taxonomy to include convergence from above ($DRIFT_2>0$, $DTREND_2<0$), convergence from below ($DRIFT_2<0$, $DTREND_2>0$), divergence from above ($DRIFT_2>0$, $DTREND_2>0$), and divergence from below ($DRIFT_2<0$, $DTREND_2<0$).[9] For all ERS zones, divergence (primarily from below) is more prevalent than convergence, with 383 regions diverging (with 357 diverging from below) compared to 339 regions converging (with 210 converging from below). For Census regions, the Northeast and South report more zones converging than diverging, while the Midwest and West report more zones diverging than converging.

For metropolitan regions, converging zones outnumber diverging zones, with 55 of the 141 converging zones located in the South and converging from below. Southern metropolitan zones that were converging from below were primarily medium and small metropolitan zones.[10] Further, the South and the Midwest also report large shares of metropolitan zones diverging from below. Of the metropolitan zones diverging from below in the South and the Midwest, most were small metropolitan zones. Overall for metropolitan zones, major metropolitan and small metropolitan areas tended to report similar shares of zones converging and diverging, while medium metropolitan zones reported more convergence than divergence.

For non-metropolitan regions, diverging zones (268) outnumber converging zones (198), with larger urban centers and small-town zones in particular reporting more divergence than convergence. For larger urban centers, the weakest results were posted by zones in the Midwest and West. For small-town zones, the weakest performance was reported in the West. The strongest performance during the period was reported by small urban centers, particularly those in the South.

These more detailed results give a much richer picture of the patterns in convergence of the 722 commuting zones. They further reinforce our aggregate results, in that stochastic convergence appears to be a bit stronger for non-metropolitan zones than for metropolitan zones. The conditional β-convergence

[9] Census regions are multi-state aggregates. Commuting zones are assigned to Census regions based on the location of the largest place within the zone.

[10] Small Metropolitan Center: population of the largest MSA in the commuting zone was less than 250,000 in 1990. Medium Metropolitan Center: population of the largest MSA in the commuting zone was at least than 250,000 but less than 1,000,000 in 1990. Major Metropolitan Center: population of the largest MSA in the commuting zone was 1,000,000 or greater in 1990 or the commuting zone is part of a CMSA. Small Town/Rural: population of the largest place in the commuting zone was less than 5,000 in 1990. Small Urban Center: population of the largest place in the commuting zone was at least 5,000 but less than 20,000 in 1990. Larger Urban Center: population of the largest place in the commuting zone was at least 20,000 in 1990.

Table 2 Convergence/divergence trends by census region and region type

Region	Regions with characteristic					Shares in 1970(%)			
	North-east	Mid-west	South	West	All	College 4+ years	Farm	Mining	Manu-facturing
All ERS zones	42	252	292	136	722	10.6	4.4	0.8	21.7
Converge above	6	44	35	44	129	10.7	3.6	0.9	22.6
Converge below	17	57	127	9	210	9.3	6.1	0.6	22.2
Diverge above	8	5	6	7	26	13.2	0.8	0.3	21.1
Diverge below	11	146	124	76	357	8.2	9.0	1.8	21.0
Metropolitan	28	70	121	37	256	11.2	2.9	0.6	22.2
Converge above	6	18	18	17	59	10.9	2.9	0.7	23.0
Converge below	10	15	55	2	82	10.0	4.3	0.5	22.3
Diverge above	6	4	5	5	20	13.2	0.8	0.3	21.1
Diverge below	6	33	43	13	95	8.8	6.1	1.3	23.2
Major metro	11	12	15	11	49	12.3	1.2	0.4	21.9
Converge above	2	4	5	5	16	11.4	1.6	0.4	23.6
Converge below	3	3	4	0	10	10.2	1.7	0.8	22.6
Diverge above	6	4	4	5	19	13.2	0.8	0.3	21.1
Diverge below	0	1	2	1	4	10.8	4.5	1.4	14.7
Medium metro	9	19	45	13	86	9.9	4.4	0.8	22.1
Converge above	4	9	6	6	25	9.9	4.2	0.9	23.5
Converge below	2	3	26	1	32	10.2	4.6	0.5	19.7
Diverge above	0	0	1	0	1	11.5	4.9	0.1	9.0
Diverge below	3	7	12	6	28	9.4	4.3	1.2	23.4
Small metro	8	39	61	13	121	8.8	8.0	1.2	23.5
Converge above	0	5	7	6	18	10.9	9.2	3.1	12.7
Converge below	5	9	25	1	40	9.2	7.9	0.2	26.0
Diverge above	0	0	0	0	0	NA	NA	NA	NA
Diverge below	3	25	29	6	63	8.1	7.9	1.4	24.0
Non-metropolitan	14	182	171	99	466	7.1	14.7	2.3	18.2
Converge above	0	26	17	27	70	8.1	14.8	3.6	15.6
Converge below	7	42	72	7	128	6.6	14.8	0.7	22.1
Diverge above	2	1	1	2	6	11.1	20.9	4.8	2.3
Diverge below	5	113	81	63	262	7.1	14.6	2.9	16.6
Larger urban center	4	38	42	21	105	7.9	11.4	1.8	19.9
Converge above	0	9	2	4	15	8.8	11.8	2.3	18.5
Converge below	3	3	19	2	27	7.1	11.8	0.7	24.4
Diverge above	0	0	0	0	0	NA	NA	NA	NA
Diverge below	1	26	21	15	63	8.2	11.2	2.2	18.1

Table 2 (continued)

Region	Regions with characteristic					Shares in 1970(%)			
	North-east	Mid-west	South	West	All	College 4+ years	Farm	Mining	Manu-facturing
Small urban center	7	88	104	39	238	6.5	16.2	2.5	18.0
Converge above	0	11	11	14	36	7.9	16.7	4.5	14.1
Converge below	3	22	44	0	69	6.4	15.7	0.7	21.6
Diverge above	0	0	1	0	1	8.5	31.0	12.7	1.2
Diverge below	4	55	48	25	132	6.4	16.4	3.2	16.5
Small town/rural	3	56	25	39	123	5.8	22.9	3.5	10.5
Converge above	0	6	4	9	19	6.1	18.6	4.6	9.4
Converge below	1	17	9	5	32	5.3	22.9	0.9	14.9
Diverge above	2	1	0	2	5	12.6	15.3	0.5	2.9
Diverge below	0	32	12	23	67	5.8	24.3	4.9	8.7

Convergence from above (DRIFT2>0, DTREND2<0), convergence from below (DRIFT2<0, DTREND2>0), divergence from above (DRIFT2>0, DTREND2>0), and divergence from below (DRIFT2<0, DTREND2<0). Educational attainment data are from the 1970 Census, U.S. Department of Commerce (1972). Employment shares are based on data from the U.S. Department of Commerce (2000). The author would like to thank Eric Thompson for making the employment share data available

analysis highlights the diversity of results across metropolitan zones and suggests strong trends both for convergence and divergence, depending on the size and location of the metropolitan zone. For non-metropolitan zones, the results are more homogeneous and strongly suggest divergence, with a preponderance of the zones diverging from below. Thus, we see selected metropolitan zones making great strides while others fall back. At the same time, most non-metropolitan zones lost ground with respect to the national economy during the period.

3.3 Education, industrial structure, and convergence

The disparity between metropolitan and non-metropolitan growth has been attributed to the industrial composition often found in non-metropolitan areas (Garnick (1984), Redman et al. (1992), Henry (1993), (Nissan and Carter (1999)). Specifically, the literature has linked the non-metropolitan specialization in farming, mining, and in some cases manufacturing, in contrast to the metropolitan specialization in producer services, to the failure of non-metropolitan regions to keep pace with metropolitan growth. The agriculture and natural resource sectors have been hit by competitive pressures and unfavorable commodity price swings since the 1970s. Manufacturing has also been subject to increasing competitive stress during the period, both from domestic and international sources. The result has been declining employment and income levels related to these industries.

Further, it is often claimed that metropolitan growth has outpaced non-metropolitan gains during the last 30 years because the small populations typically found in non-metropolitan regions make it difficult for them to attract the highly specialized producer services firms, and their highly educated workers, which have helped to spur metropolitan growth. Indeed, at the metropolitan level Crihfield and Panggabean (1995) found a strong positive association between levels of educational attainment and U.S. metropolitan area growth.[11] However, it is possible that educational attainment may improve growth even for non-metropolitan areas, a view which receives some support from Beeson et al. (2001) and Rupasingha et al. (2002) who find that educational attainment had a statistically significant influence on U.S. county (both metropolitan and non-metropolitan) growth.

Table 2 also presents indicators of industrial structure and human capital for 1970 for metropolitan and non-metropolitan zones, by population size and convergence trend. I focus on data at the beginning of the period in order to reduce possible simultaneity problems.[12] In 1970, the share of residents with four-or-more years of college was 10.6% across all 722 ERS zones. As expected, educational attainment levels were higher in metropolitan zones (11.2%) than non-metropolitan zones (7.1%). The highest levels of educational attainment are found in those zones that diverged from above, with 13.2% of their residents possessing four-or-more years of college in 1970. In a similar vein, educational attainment was lowest for those zones that diverged from below, with 8.2% of their residents with four-or-more years of college, and these zones also posted lower levels of educational attainment than did converging zones.

These results are sustained for metropolitan zones, with the zones diverging from above boasting much higher levels of educational attainment than those diverging from below or converging. Non-metropolitan zones mirror overall results in that educational attainment is always highest for zones that diverge from above. However, the rest of the results are a bit more mixed, with non-metropolitan zones that diverge from below often reporting higher levels of educational attainment than zones that converge from below.

The results on industrial structure, measured by employment shares, suggest that a strong specialization in farming and natural resource extraction has tended to be associated with weaker economic performance during the period. In particular, the highest employment shares in farming and mining are associated with zones that diverged from below during the 30-year period. In contrast, for the 722 ERS zones, there appears to be little correlation between convergence trends and the 1970 employment share in manufacturing.

Metropolitan zone results are similar, although downwardly divergent zones post somewhat higher levels of manufacturing employment than do upwardly divergent zones. The non-metropolitan results initially seem very different. For instance, employment shares in farming and mining were highest in the few non-metropolitan zones that diverged from above, while the manufacturing employment share was the

[11] In contrast, Lall and Yilmaz (2001) present conditional β-convergence results suggesting that, after controlling for spatial spillovers, educational attainment no longer has a significant impact on U.S. state growth. They do find evidence that the educational attainment of first-order-contiguous states has a positive impact on state growth, probably through cross-state commuting relationships.

[12] This will not eliminate possible endogeneity problems, however. As an anonymous reviewer pointed out, industrial structure and levels of educational attainment may have been previously influenced by income levels. Crihfield and Panggabean (1995) find that educational attainment positively influences metropolitan income growth even after significant econometric attempts to control for endogeneity.

lowest. However, it is important at this point to remember that only six non-metropolitan zones were upwardly divergent during the period. The remaining results for non-metropolitan zones suggest a mixed impact of farming–mining-manufacturing specialization. Some of the highest employment shares in farming and mining were posted by zones converging from above and diverging from below (regions with negative coefficients on $DTREND_2$). In contrast, non-metropolitan zones that are converging from below posted the largest manufacturing shares in 1970. Overall, this suggests that growth has been slower in non-metropolitan regions which began the period with farming and mining specializations than it has been in non-metropolitan regions with larger shares of employment in manufacturing.

4 Conclusion

The evidence presented here suggests that non-metropolitan regions are diverging from below the U.S. average, while metropolitan regions show mixed evidence of convergence. The results also suggest the positive impact of human capital accumulation on economic growth and convergence. Regions with high levels of educational attainment tend to have high initial income levels and also strong subsequent income growth. Further, since nearly all of the zones that diverge from above are metropolitan, this suggests that agglomeration economies may have played an important role in the observed convergence trends. It further suggests that the influence of diminishing returns and migration flows may not be sufficient to counter balance the benefits of agglomeration economies in metropolitan regions.

This may raise troubling issues for economic development efforts designed to support non-metropolitan growth, particularly with respect to small non-metropolitan regions with relatively low initial income levels, since the impact of human capital accumulation on these regions appears to be muted. It also highlights the need for further research into the economic characteristics and policy choices of regions diverging from above and below the U.S. average. Future investigations would benefit from a focus on the impact of state and local tax and spending policies on sub-state regional convergence.

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